

A close examination of the figure shows that, not only do we get types of simple bright flashes, but we obtain dark flashes with bright cores and bright flashes with dark boundaries.

Now A (Fig. 6) is exactly similar in type to the dark flash in Fig. 4, A, while the two bright flashes in C correspond also to the bright flashes in Fig. 6.

The peculiar flash at C (Fig. 4) is an exact counterpart of D in Fig. 5.

This experiment leads me to conclude, therefore, that Mr. Clayden's hypothesis is entirely corroborated, and explains very satisfactorily the types of flashes illustrated in the above reproductions from photographs.

In studying Fig. 4 in the light of these results, we can form a good idea of the order of appearance of the flashes. That marked A was undoubtedly the first to occur (if the plate had been immediately developed, it would have come out bright); then the flash B made its appearance, and, being so intense, illuminated the neighbouring region round A that the image of A on the film was affected chemically. C was probably next in order of occurrence, but, being more distant and therefore fainter, did not have any effect on A or B. C, however, was affected by subsequent flashes, which were not bright enough to illuminate the field to alter the intense bright flash B in any way, but which were capable of adding dark borders to its sides. The above order of appearance is to a great extent corroborated by the apparent distances and intensities of the flashes.

There seems very little doubt now that, by varying the intensities of the sparks and that of the illuminated background, one can produce any combination of bright and dark flashes. A glance again at Fig. 6 will show that the appearance of a flash depends simply on the magnitude and presence or absence of the core. The following table sums up the six chief types of flashes that probably can be obtained: the reader will notice that there is a complete cycle commencing and terminating with a dark flash.

1. Dark flash, no core.
2. " " small bright core.
3. { Dark flash, broad bright core;
or,
Bright flash, narrow dark borders.
4. Bright flash, no dark borders.
5. " " small dark core. This would represent an ordinary weak reversal.
6. { Bright flash, broad dark core; This would represent an
or, ordinary strong reversal.
Dark flash, narrow bright borders.
7. Dark flash, no bright borders;
or,
same as No. 1 above.

In the above list photographs have *actually* been obtained of all the types of flashes that came under the headings 1-5. I have examined all my *negatives* to search for the type No. 6, with the result that I have not found a representation of this kind of flash.

It may be remarked that the types 1-3 are produced as a direct consequence of the Clayden effect, and should therefore only appear on plates which contain more than one flash. The other types, which depend simply on the intensity of the flash, should be obtained when even only one flash appears on a plate.

We thus see that actual photographs of lightning bear out what we should expect from laboratory experiments, and we must therefore answer in the negative the question asked in the first line of this article.

Dark lightning flashes therefore do not exist in nature, but their appearances on photographs are due to some chemical action which takes place in the gelatine film.

In closing this article I wish to draw attention to the great interest which is attached to this most fascinating subject. Every one who has a camera can help in the

elucidation of the several points to be studied, and most probably bring new facts to light. The photography of lightning flashes during the night is an easy subject, for one has simply to turn the camera towards the dark sky, and the lightning does all the exposing itself. Unfortunately it is not every one who is aware of this fact, and I know of two instances of amateurs who exposed plates during the same storm and at the same place where I obtained the above pictures, but they tried to *catch the flashes by using instantaneous shutters*. Whether they obtained any positive results I do not know, but one could make a very fair guess.

If any readers of this article would be willing to exchange interesting unmounted lightning photographs obtained by them for copies of any of the above illustrations from the original negatives, the writer would esteem it a favour. (Address: 16 Penywern Road, South Kensington, S.W.) This request suggests to me that it would be important for the furtherance and development of this subject, if there were some recognised "Central-Stelle" to which copies of all such photographs could be sent. Those studying the subject would not then be so much hampered in searching for references to accounts of original observations and reproductions, if a fairly complete collection of copies from original negatives were made accessible.

WILLIAM J. S. LOCKVER.

NOTES.

PROF. A. GRAY, F.R.S., Professor of Physics in the University College of North Wales, has been appointed to succeed Lord Kelvin in the chair of Natural Philosophy in the University of Glasgow, and will at once commence his new duties.

THE HARVEIAN ORATION will be delivered at the Royal College of Physicians, London, on October 18, by Dr. G. Vivian Poore, and the Bradshaw Lecture on November 2, by Dr. A. Foxwell.

MAJOR RONALD ROSS and other members of the Liverpool Malaria Expedition have returned to this country very well satisfied with their labours. On the advice of the expedition the authorities at Sierra Leone decided to use every means to exterminate the malaria-spreading mosquito. Major Ross is of opinion that the white population is not careful enough, and that the houses are badly constructed, and compare unfavourably with the residences of white people in India, which are constructed on plans that give the inhabitants every chance of health, despite the tropical climate. He attaches great importance to this question of the construction and situation of the houses. Dr. Fielding Ould, a member of the expedition, has remained behind to consult with the medical officers on the coast respecting measures to be taken for the extermination of the malaria mosquito in the neighbourhood of the principal towns. During the investigation one member of the expedition, Mr. Austin, suffered from malaria; he became infected through sleeping one night without the protection of mosquito curtains.

DRS. CALMETTE AND SALEMENI, who were sent out by the Pasteur Institute as a commission to study and combat the plague in Oporto, have returned to Paris more than satisfied, it is said, with the success attending their efforts with the anti-plague serum. Dr. Calmette is of opinion that the Portuguese might easily free themselves from plague if they would rigorously carry out the measures which have been recommended to them, and in particular if they would inoculate all the inhabitants of suspected quarters. This, however, they appear unwilling to do.

ACCORDING to the *Civil and Military Gazette*, Lahore, the Indian Government has under its consideration a somewhat comprehensive scheme for the establishment of research laboratories

in various parts of India, and the appointment of health officers to the charge of them. The present laboratory at Muktesar will, it is understood, be further developed, and the staff increased, the establishment becoming the central research laboratory for India, and health officers will be appointed to the charge of laboratories at Calcutta, Madras, Bombay, Agra and Lahore, the new department of bacteriology being ordinarily manned by officers of the Indian Medical Service.

DR. CARL PETERS has, it is stated by Reuter, left Portuguese territory and crossed into Mashonaland. Part of his expedition has, however, been left in the neighbourhood of the ancient ruins re-discovered by him near the Zambesi. Dr. Peters' intention is reported to be the establishment of a permanent station on the Inyanga Highlands, and to explore from that point the whole of Mashonaland from north to south. The explorer claims to have discovered mica, saltpetre and diamonds in a district practically uninhabited, at an altitude of 8000 feet, and, he believes, easily capable of cultivation. As the rainy season is now setting in Dr. Peters will, after exploring some districts on the Pungwe River, proceed to Beira *en route* for England.

WE regret to have to record the death, at the age of fifty-eight, of Mr. John Donaldson, a partner of the engineering firm of Thornycroft, which took place last week. Mr. Donaldson had much to do with the introduction of fast torpedo boats into the British Navy, and was a great believer in his firm's water-tube boiler. He was a member of the Institution of Civil Engineers, the Institution of Naval Architects and the Institution of Mechanical Engineers.

Science announces the death, at the age of eighty-four, of Chief Justice C. P. Daly, who for many years took a deep interest in scientific matters, particularly in the branches of geography and botany. Mr. Daly was for thirty-six years president of the American Geographical Society, and was largely instrumental in founding the Society's extensive library, and in securing the endowment of its new building. He also rendered good service to the Botanical Garden of New York, and was one of its managers.

MONUMENTS in memory of Siemens and Krupp will be unveiled at Charlottenburg on the 19th inst., the occasion being the centenary of the Technical Institute of that town.

IT having been decided by a number of friends and pupils of the late Dr. Friedel to place a bust and enlarged photograph of him in the hall of the Sorbonne, a circular asking for subscriptions has been distributed. The bust will be the work of M. Uitain, who executed that of Schutzenberger, and is estimated to cost 3000 francs. Subscriptions should be sent to M. Chason, at the Laboratory of Organic Chemistry, Faculty of Science, the Sorbonne.

THE highest observatory in Germany is now completed. It is situated on the Schnee Koppe, the highest summit of the Silesian Mountains, at an elevation of 5216 feet. It will be managed as an institution of the Prussian State.

MR. W. D. HUNTER, special agent of the Division of Entomology, Department of Agriculture, has, says *Science*, returned to Washington, after having studied the Turtle Mountain region in North Dakota and Manitoba, supposed to be a permanent breeding-ground of the Rocky Mountain locust. This, it is reported, he found not to be the case, and he thinks that the probable breeding-ground is the Assiniboine River, north and east of Regina, a region that will be investigated next season.

ACCORDING to *Nature Notes*, a circular has just been issued to all Catholic missionaries by the Sacred Congregation of the

Propagation of the Faith, urging them to use such opportunities as the locality of their mission work affords for the collection of natural history specimens, to be given to scientific societies and institutions. The intention, it is asserted, is not only to interest and encourage such missionaries as are keen naturalists, but also to remove the reproach so commonly held that the Church does not look with favour upon science, and especially biological science.

THERE being much difference of opinion as to the kind of ration best adapted for soldiers and sailors in tropical climates, a prize of 100 dollars, or a medal of that value, as the successful competitor may select, has, says the New York correspondent of the *Lancet*, been offered by Dr. Louis L. Seaman for the best thesis on the subject, viz. "The Ideal Ration for an Army in the Tropics." The competition is open to all commissioned medical officers of the U.S. army and navy, regular and volunteer. The prize is offered through the "Military Service Institution of the United States." The executive council of that body has decided that all papers should be submitted by March 1, 1900.

THE joint committee of the Glamorgan County Council and Cardiff Corporation invite applications for the post of bacteriologist and lecturer, to work under the direction of the medical officers of health of the borough and county. Full particulars as to the duties and emoluments of the office will be found in our advertisement columns.

THE American Mathematical Society, which was established on its present basis so recently as 1894, appears to be in a flourishing condition. Its membership is now over three hundred, and at its recent summer meeting, held at Columbus, Ohio, simultaneously with that of the American Association, no fewer than twenty-four papers were read.

IN the address delivered at the opening of the winter session of the Jenner Institute of Preventive Medicine, on Monday last, Dr. Macfadyen gave an account of the institute and its work. In the course of his remarks he said the Anti-toxin Department was engaged in preparing various therapeutic serums, notably the anti-diphtheritic serum, as well as in research in this important field of work. The primary object of the institute was research, but facilities were afforded for post-graduate instruction in preventive medicine and bacteriology. The students had come from all parts of the world, and a considerable amount of original work had been done by those trained in the laboratories. Investigations were at present being made at the institute with reference to the possible cure or prevention of typhoid fever, tuberculosis and other diseases. The diagnosis of infectious diseases was constantly being carried out for the main parishes of London, as well as the investigation of questions affecting the public health on behalf of sanitary authorities. The chemical and State medicine laboratories would find much to do in connection with water, sewage, food, poisons, &c. A notable addition had been made to the resources of the institute in the Hansen Laboratory for the study of the practical application of bacteriology to industrial and technical processes, and the most important results might be anticipated in the future from this branch of investigation.

THE New York *Electrical Review* gives particulars of a recently invented electrical and chemical fire-alarm apparatus, which gives its indications when the atmosphere becomes so vitiated with smoke that it will not support the combustion of a gas flame. In the interior of the apparatus a small gas flame constantly warms a thermostatic bar, the electric circuit through the apparatus being normally open as long as the flame holds out to burn. If the air in the apartment in which the apparatus is installed becomes vitiated with smoke, the little

gas flame goes out, and the thermostatic bar, cooling off, closes the circuit and gives the alarm.

At the International Fishery Congress held at Bergen in 1898, and at that held at Dieppe, an effort was made to start the publication of an "International Review of Fisheries and Fish Culture," which should serve to maintain constant relations between specialists of this branch of science working in different countries. Such efforts were, however, unsuccessful so far as a favourable decision of the Congresses being arrived at was concerned. This being so, and the want of such an organ being considered a very real one, the Russian Imperial Society of Fish Culture and Fisheries has undertaken the publication of such a periodical as has been mentioned, to contain articles in German, French and English. The first number, dated August, has just reached us and contains many interesting contributions, among which may be mentioned "A Short Comparison between the Caspian and the Baltic Seas," "Short Notices of the Fisheries of Sweden," "Fish Culture in the United States," "Contributions to the Study of Fishing Apparatus." The following programme will give an idea as to the scope of the new journal, which has made a very creditable beginning :—New facts pertaining to fish- and oyster-culture (statistics, new methods used in fish-culture, inventions, &c.). New facts and data pertaining to fisheries (statistics, fishing news, inventions, new laws, &c.). Professional education of fishermen and of workmen engaged in the manufacture of preserved fish. Novelties in the manufacture of fish products (new patents, new canneries, &c.). Improvements in the fish-trade and in the methods of carrying fish (fish-markets, cold-storage houses, refrigerator-cars ; new duties on imported fish). The work of fishery-societies. Review of scientific investigations connected with fisheries. New books on fish-culture and fishing. Personal notes.

IN a recent number of the Paris *Comptes rendus* (vol. cxxix, p. 417), M. L. Teisserenc de Bort contributes some interesting particulars relating to the temperature of the free air and its variations from observations obtained from ninety unmanned balloons, sent up from his observatory at Trappes since April 1898. The observations have been spread over every month ; seven of the ascents exceeded 14,000 metres, twenty-four 13,000 metres, and fifty-three attained a height of 9000 metres. The discussion of the observations exhibits the following general results : (1) The temperature at various heights presents during the course of the year important and greater variations than have been admitted from older series of observations made in manned balloons. The temperature of 0° C. is found at very different altitudes, varying from the level of the ground in winter to above 4000 metres in summer. The isotherm of -25° C. is met with about 3000 metres in winter and above 7000 m. in summer ; in September it was observed even above 8000 m. The isotherm of -40° C. was several times found as low as 6000 m., and is generally met with about 9000 m. and even higher towards the end of summer. The temperature of -50° C. has never been recorded below 8000 m. ; its greatest altitude was at 12,000 m. (2) There appears to be a marked tendency to an annual variation of temperature even up to 10,000 m., the maximum being about the end of the summer, and the minimum near the end of the winter. The observations given in a table appended to the paper do not show such a rapid variability with height as has been generally supposed ; it appears, further, to vary with the type of weather.

IN the *Atti dei Lincei* viii. (2) 4, Dr. D. Lo. Monaco and L. Panichi give a second note on the action of quinine on the parasite of malaria. The most remarkable result is the effect of solutions of strengths lying between certain limits in provoking the exit of the parasites from the red corpuscles, when the

parasites are in the second or adult stage. The authors now find that the action of quinine on the endoglobular parasites of spring fever may be thus summed up : (1) in very dilute solutions it excites them ; (2) in less dilute solutions the excitement, which reaches its maximum phase in the exit of the parasite from the red corpuscle, is preceded by a brief contraction ; (3) in strong or concentrated solutions it paralyses them. There is still some doubt as to the dose of quinine which should be administered in order to effect a cure, and this probably varies in different patients ; but it appears that the doses commonly adopted must be regarded as excessive, and that the rational dose suited for curing an attack of spring fever is comprised between half a gramme and a gramme of bisulphate of quinine.

THE *Sitzungsberichte der physikalisch medicinischen Societät* (Erlangen) contains abstracts of several experiments on kathodic rays. The first of these, by Prof. E. Wiedemann and A. Wehnelt, is a simple proof that while kathodic rays are deflected by a magnet, the Goldstein rays are not directly influenced by magnetic force. In the second note the same authors deal with the question of the repulsion of converging kathodic rays, and describe experiments showing that the rays emanating from a hollow cathode cut one another, and that this result is not inconsistent with Weber's experiments. The third note deals with the variations in the potential of discharge in the kathodic dark space, and their independence of ultra-violet or Röntgen rays. Prof. E. Wiedemann contributes a further note on the "simple" kathodic rays of Deslandres. M. Arnold discusses the influence of the luminosity of the anti-kathode on the emission of Röntgen rays ; and A. Moffatt gives an interesting note showing that the power of Röntgen rays (*i.e.* their energy divided by the time) is greater than is commonly supposed, and may be about 1 to 10 calories per second.

THE Calabro-Messinese earthquake of November 16, 1894, occupies a prominent place among recent Italian shocks. A Government commission was immediately appointed to study it, but, for various reasons, the complete report has not yet been published. Prof. Riccò, however, has contributed a summary of the seismological section to the Royal Accademia dei Lincei (*Rendiconti*, vol. viii. pp. 3-12, 35-45), and has illustrated it by a map showing the isoseismal lines of the principal shocks of 1894 and 1783. The meizoseismal area of the earthquake of 1894 is situated about twenty miles north-east of Reggio, and the isoseismal lines (which depend, however, on observations from only 170 places) are roughly concentric with this area, but they expand towards the north-west, and are rather crowded together towards the south-east. As a general rule, they follow the boundaries of the great crystalline masses. The total disturbed area (included within the isoseismal 2) is about 44,000 square miles. Nearly a thousand houses were completely destroyed, and more than 44,000 were damaged ; about a hundred persons were killed, and a thousand wounded. The earthquake was registered by seismographs at seven Italian observatories, and by the horizontal pendulum at Nicolaiew. A putorometer at Catania indicated a sudden rise of 17 mm. in the well-water, followed by a fall of 14 mm., after which the surface returned nearly to its original position. The mean surface-velocity of the larger vibrations in Italy was almost exactly 2 km. per second ; but it varied with the distance, for the hodograph (see NATURE, vol. lii. p. 632) is at first convex to the axis of the distance and afterwards concave. Prof. Riccò remarks that the earthquake of 1894 may be regarded as an after-shock of the great earthquake of 1783, its epicentre being displaced slightly to the south-west ; but its intensity was much less, for the meizoseismal area (that bounded by the isoseismal 10) is only one-sixth of that of the earthquake of 1783.

THE department of vertebrate palaeontology of the American Museum of Natural History reports that in 1898 the second expedition for Dinosaurs was sent out to Wyoming in charge of Dr. J. L. Wortman, with a party of four. Deposits of Dinosaur bones very favourably situated were found. In all some 60,000 pounds of fossils were secured. This splendid collection reached the museum entirely uninjured, and one-third of it has already been worked out. The fore and hind limbs of these monster reptiles will furnish subjects of great interest for the public. The exhibition hall has been enriched by the skeletons of two great Dinosaurs. A second party, under the direction of Dr. W. D. Matthew, was at work in 1898 in the fossil beds of north-western Kansas and south-western Nebraska. The Bad Lands of north-eastern Colorado were also found to be a rich collecting-ground. Skulls and parts of skeletons were secured, filling many important gaps in the Museum collection. Portions of skeletons and skulls of fossil camels were found, among which is included a gigantic one of the size and proportions of the giraffe. The party also acquired a large amount of other material. It is a little surprising to notice that, though the museum is doing so much to promote educational and scientific advancement in New York, the income in 1898 was insufficient to meet current expenses.

THE monograph, "The Later Extinct Floras of the United States," left unfinished by the death of Prof. Newberry, is to be completed by Dr. Arthur Hollick.

THE Essex Technical Instruction Committee have issued, through the County Technical Laboratories, Chelmsford, a report, compiled by Mr. T. S. Dymond, of a visit paid to Holland by Essex agriculturists in May and June of the present year. The report is interesting reading, and gives a brief outline of the more prominent features of Dutch farming. A perusal of the pamphlet will supply English agriculturists with a few hints which in some cases might with advantage be acted upon in this country.

THE report of the Connecticut Agricultural Experiment Station for 1898 has just been published, and is full of valuable matter. Several of the reports contained in the volume should be of interest and service, not only to inhabitants of the State of Connecticut, but to many others.

A SERIES of illustrated articles on "Radiography," by Mr. James Quick, is begun in the October number of *Science Gossip*. The same issue also contains the continuation of articles on "British Freshwater Mites" and "Butterflies of the Palaearctic Region," and numerous other contributions of popular science.

THE Royal Technical Institute, Salford, has issued its calendar for the session 1899-1900. The list of classes is a large one, and, judging from the illustrations of laboratories, workshops, &c., given, the institute is equipped in a very efficient manner.

THE additions to the Zoological Society's Gardens during the past week include a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, presented by Mr. M. P. Peeker; a Chopi Starling (*Aphobus chopi*) from Brazil, presented by Mr. W. R. Routledge; two Orange-flanked Parakeets (*Brotogeris pyrrhopterus*) from Western Ecuador, presented by Mr. W. H. St. Quintin; three Palm Squirrels (*Sciurus palmarum*) from India, presented by Mrs. M. E. Tracy; a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Guinea Baboon (*Cynocephalus sphinx*) from Africa, a Striped Snake (*Tropidonotus ordinatus sirtalis*) from North America, three Common Snakes (*Tropidonotus natrrix*), a Four-lined Snake (*Coluber quatuorlineatus*), a Tessellated Snake (*Tropidonotus tessellatus*), a Smooth Snake (*Coronella austriaca*), a

Glass Snake (*Ophiosaurus apus*), an Eyed Lizard (*Lacerta ocellata*), six Slowworms (*Anguis fragilis*), European, deposited; two Baillon's Aracaris (*Andigena bailloni*) from Brazil, a White-browed Amazon (*Chrysotis albifrons*) from Honduras, twelve Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, purchased; a Wapiti Deer (*Cervus canadensis*), an Axis Deer (*Cervus axis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET GIACOBINI (1899 E).—We have received the following elements and ephemeris (calculated by Herr J. Moller) from the Centralstelle at Kiel.

Elements.

$T = 1899 \text{ Aug. } 26^{\text{th}} 07^{\text{m}}$ Berlin Mean Time.

$$\left. \begin{array}{l} \omega = 358^{\circ} 46' \\ \Omega = 273^{\circ} 26' \\ i = 79^{\circ} 53' \end{array} \right\} 1899^{\circ} \\ \log q = 0^{\circ} 23796$$

Ephemeris for 12h. Berlin Mean Time.

1899.	R.A. h. m. s.	Decl. °	Br.
			... 0' 93
Oct. 5	16 36 59	-3 18' 7	... 0' 93
7	39 50	2 41' 4	... 0' 86
9	42 42	2 5' 1	... 0' 86
11	45 34	1 29' 5	... 0' 81
13	48 27	0 54' 6	... 0' 81
15	51 20	-0 20' 3	... 0' 76
17	54 14	+0 13' 3	... 0' 76
19	16 57 8	+0 46' 4	

HOLMES' COMET (1899 d).—M. H. J. Zwiers gives in *Ast. Nach.* (Bd. 150, No. 3595) an extended ephemeris of this comet, in the hope that it may still be observed by any one having the necessary optical power, and thus permit of a more exact determination of this orbit.

1899.	R.A. h. m. s.	Decl. °	(r) ⁻²	(rΔ) ⁻²
Oct. 12	2 59 45' 75	+48° 10' 16' 1		
13	58 53' 29	16 57' 5		
14	57 58' 94	23 18' 9		
15	57 2' 77	29 19' 7	0' 1647	0' 05900
16	56 4' 85	34 59' 8		
17	55 5' 26	40 18' 7		
18	54 4' 07	45 16' 1		
19	2 53 1' 35	+48 49 51' 7		

THE ROTATION OF THE SUN.—In a publication issued from the Lund Observatory, Herr C. A. Schultz Steinheil gives the results of his complete discussion of Dunér's spectroscopic determinations of the sun's rotation, extending over the period June 3, 1887-May 18, 1889.

Taking Dunér's spectroscopic values for different positions round the limb and the centre, these are reduced to heliographic coordinates by a table of declination corrections supplied to the author by M. Dunér, and so furnish over 600 equations of condition, which when grouped according to latitude are brought down to 22. Solving these by the method of least squares, the final result appears as

$$\begin{aligned} x &= 2'054 \pm 0'0042 \\ i &= +18^{\circ} 12 \pm 0'25 \\ \Omega &= +28^{\circ} 00 \pm 0'50 \end{aligned}$$

This means that the result of the new discussion of Dunér's spectroscopic observations is that the sun rotates so that a point on its equator moves with a uniform velocity of 2'054 kilometres per second round an axis the inclination of which towards the axis of the ecliptic is 18° 12', the longitude of the intersection of the sun's equator with the ecliptic being +28° 00'.

The value of the velocity $x=2'054$ is not the true velocity, but the synodic; we get the true value by adding $2d \sin \omega$, where d is the velocity of the earth in its orbit in kilometres per second, and ω the semi-diameter of the sun, expressed in angular measures as seen from the earth.

THE POLARIS MULTIPLE STAR.—Prof. W. W. Campbell is reported to have stated in the *New York Times*:

"The recent observations of Polaris at the Lick Observatory